

Serial No. 10/796,578
Response to Office Action

IN THE CLAIMS

A listing of all claims and their current status in accordance with 37 C.F.R. § 1.121(c) is provided below.

1. (currently amended) A method for processing signals in a pulse oximeter to determine oxygen saturation and pulse rate, comprising:

receiving waveforms corresponding to two different wavelengths of light from a patient; ensemble averaging said the waveforms in a first ensemble averager using variable weights;

calculating a pulse rate based on an output of said the first ensemble averager; selecting first metrics for the first ensemble averager to optimize calculating the pulse rate;

normalizing said the waveforms to produce normalized waveforms; ensemble averaging said the normalized waveforms in a second ensemble averager using variable weights; and

calculating an oxygen saturation based on an output of said the second ensemble averager; and

selecting second metrics for the second ensemble averager to optimize calculating the oxygen saturation.

2. (cancelled)

3. (currently amended) The method of claim [2] 1 wherein said the first and second metrics both include an arrhythmia metric for detecting an arrhythmic pulse, said the arrhythmia metric for said the first metrics, in connection with calculating [a] the pulse rate, having a lower associated threshold for recognizing arrhythmia than said the arrhythmic metric for said the second metrics.

Serial No. 10/796,578
Response to Office Action

4. (currently amended) The method of claim [2] 1 wherein said the first and second metrics both include a short term metric which is a measure of short-term changes in pulse amplitude;

said the first ensemble averager increasing an ensemble averaging weight in response to a short-term decrease in pulse amplitude faster than said the second ensemble averager.

5. (currently amended) A pulse oximeter for determining oxygen saturation and pulse rate, comprising:

a detector which receives configured to receive waveforms corresponding to two different wavelengths of light from a patient;

a first ensemble averager configured to average the waveforms;

a pulse rate calculator, coupled to configured to calculate a pulse rate based on an output of said the first ensemble averager;

a normalizer coupled to said detector for normalizing said configured to normalize the waveforms to produce normalized waveforms;

a second ensemble averager configured to average the normalized waveforms; and

an oxygen saturation calculator configured to calculate an oxygen saturation based on coupled to an output of said second ensemble averager; and

a signal quality metric calculator configured to provide first metrics for the first ensemble averager to optimize calculating the pulse rate, and second metrics for the second ensemble averager to optimize calculating the oxygen saturation, wherein the ensemble averagers are configured to ensemble average using variable weights.

6. (cancelled)

7. (currently amended) A method for processing signals in a pulse oximeter to determine oxygen saturation and pulse rate, comprising:

receiving waveforms corresponding to two different wavelengths of light from a patient;
low pass filtering said the waveforms in a first low pass filter;

Serial No. 10/796,578
Response to Office Action

calculating a pulse rate based on an output of said the first low pass filter;
normalizing said the waveforms to produce normalized waveforms;
low pass filtering said the normalized waveforms in a second low pass filter; and
calculating an oxygen saturation based on an output of said the second low pass filter;
selecting first metrics for the first low pass filter to optimize the calculating the pulse rate;
and
selecting second metrics for the second low pass filter to optimize calculating the oxygen
saturation.

8. (cancelled)
9. (currently amended) The method of claim [8] 7 wherein:
the low-pass filtering weight associated with said the first low pass filter is based on a frequency ratio metric which quantifies the frequency-content of said the waveforms relative to a pulse-rate estimate.
10. (currently amended) The method of claim [8] 7 wherein:
a low-pass filtering weight for said the second low pass filter is based on a frequency ratio metric which quantifies the frequency-content of said the waveforms relative to a pulse-rate estimate that metric, and
a separate Ratio-of-Ratios variance metric.
11. (currently amended) A method for processing signals in a pulse oximeter to determine oxygen saturation and pulse rate, comprising:
receiving waveforms corresponding to two different wavelengths of light from a patient;
low pass filtering and ensemble averaging said the waveforms in a first low pass filter and ensemble averager;

Serial No. 10/796,578
Response to Office Action

calculating a pulse rate based on an output of said the first low pass filter and ensemble averager;
normalizing said the waveforms to produce normalized waveforms;
low pass filtering and ensemble averaging said the normalized waveforms in a second low pass filter and ensemble averager; and
calculating an oxygen saturation based on an output of said the second low pass filter and ensemble averager.

12. (currently amended) A pulse oximeter for determining oxygen saturation and pulse rate, comprising:

a detector which receives waveforms corresponding to two different wavelengths of light from a patient;
a first low pass filtering filter configured to filter the waveforms;
a pulse rate calculator, coupled to configured to calculate a pulse rate based on an output of said the first low pass filter;
a normalizer coupled to said detector for normalizing said configured to normalize the waveforms to produce normalized waveforms;
a second low pass filter configured to filter the normalized waveforms; and
an oxygen saturation calculator coupled to configured to calculate an oxygen saturation based on an output of said the second low pass filter; and
a signal quality metric calculator configured to provide first metrics for the first low pass filter to optimize calculating the pulse rate, and second metrics for the second low pass filter to optimize calculating the oxygen saturation, wherein the low pass filters are configured to ensemble average using variable weights.

13. (cancelled)

Serial No. 10/796,578
Response to Office Action

14. (currently amended) The pulse oximeter of claim 12 wherein:
the low-pass filtering weight associated with said the first low pass filter is based on a frequency ratio metric which which quantifies the frequency-content of said the waveforms relative to a pulse-rate estimate.
15. (currently amended) The pulse oximeter of claim 12 wherein:
a low-pass filtering weight for said the second low pass filter is based on a frequency ratio metric which which quantifies the frequency-content of said the waveforms relative to a pulse-rate estimate that metric, and
a separate Ratio-of-Ratios variance metric.
16. (currently amended) A pulse oximeter for determining oxygen saturation and pulse rate, comprising:
a detector which receives waveforms corresponding to two different wavelengths of light from a patient;
a first low pass filtering filter and ensemble averager configured to filter and to average the waveforms;
a pulse rate calculator, coupled to configured to calculate a pulse rate based on an output of said the first low pass filter and ensemble averager;
a normalizer coupled to said detector for normalizing said configured to normalize the waveforms to produce normalized waveforms;
a second low pass filter and ensemble averager configured to filter and to average the normalized waveforms; and
an oxygen saturation calculator coupled to configured to calculate an oxygen saturation based on an output of said the second low pass filter and ensemble averager.

Serial No. 10/796,578
Response to Office Action

17. (currently amended) A method for processing signals in a pulse oximeter to determine oxygen saturation, comprising:

receiving waveforms corresponding to two different wavelengths of light from a patient; processing a new waveform after a pulse period trigger to ensemble average with a historical average waveform; and

when said the new waveform differs from said the historical average waveform by more than a predetermined threshold, interpolating between the new waveform and the historical average waveform for a first few samples of a new, composite historical average waveform.

18. (currently amended) The method of claim 17 wherein said the first few samples are four samples, and said the interpolations are at 80%, 60%, 40%, and 20% of the difference between the new waveform and the historical average waveform.